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F. B. Mear

MEMOIRS  
OF THE  
GEOLOGICAL SURVEY  
OF  
THE UNITED KINGDOM.

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*Figures and Descriptions*

ILLUSTRATIVE OF  
BRITISH ORGANIC REMAINS.

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DECADE III.

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PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF HER MAJESTY'S TREASURY.

LONDON:  
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE:  
PUBLISHED BY  
LONGMAN, BROWN, GREEN, AND LONGMANS.  
1850.

## NOTICE.

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PALÆONTOLOGICAL researches forming so essential a part of geological investigations, such as those now in progress by the Geological Survey of the United Kingdom, the accompanying plates and descriptions of British Fossils have been prepared as part of the Geological Memoirs. They constitute a needful portion of the publications of the Geological Survey, and are taken from specimens in the public collections, or lent to the Survey by those anxious to advance this branch of the public service.

The plan proposed to be followed in the work, of which this Decade forms a part, is as follows :—

To figure in elaborate detail, as completely as possible, a selection of fossils, illustrative of the genera and more remarkable species of all classes of animals and plants the remains of which are contained in British rocks ; to select especially such as require an amount of illustration which, to be carried out by private enterprise, would require a large outlay of money, with little prospect of a return, and a long time to accomplish, but which, by means of the staff and appliances necessarily employed on the Geological Survey, can be effected at small cost, and with a rapidity demanded by the publication of the Maps and Memoirs of the Survey ; thus, it is hoped, affording an aid to those engaged in the sciences with which this work is connected, that they might not otherwise have possessed, and which may materially promote the progress of individual research.

H. T. DE LA BECHE,  
*Director-General.*

*Geological Survey Office, Jermyn Street,  
30th June, 1850.*

## BRITISH FOSSILS.

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### DECADE THE THIRD.

THE third Decade of representations of British Fossils follows up the subject of the first, and continues the series of illustrations of the genera and species of extinct Echinodermata, especially those belonging to the orders *Asteriadae* and *Echinidae*.

The genera illustrated in this Decade are partly new, partly long-established ; so also with the species, some of the most remarkable of unpublished forms having been selected, as well as some of the commonest and best known fossils. Yet, even respecting those which are so familiar that their whole history is believed to have been long ago made out, there is so much to be cleared up, so many points of structure hitherto very imperfectly or not at all elucidated, and such an accumulation of synonyms, that their investigation is much more laborious, and occupies much longer time, than inquiries into entirely new types. Thus, three of the fossils figured and described in this Decade, *Hemicidaris intermedia*, *Galerites albogalerus*, and *Micraster cor-anguinum*, are so familiar to geologists and naturalists, so abundant and so well preserved, that authors do not hesitate to cite them without comment, as if they were free from any obscurity. Nevertheless, I may say confidently, that not until now has the literature of these well-known and often-described forms been cleared up, and many of the most important points in their organization made known. Common as they are, no representations of them, presenting sufficient details of their structure, have ever appeared before.

Among the new forms now first described and figured, some are of singular interest. Two of them, the *Lepidaster Grayii* and the *Tropidaster pectinatus*, are not only new as species, but unquestionably possess features entitling them to become the types of new genera. Of those

belonging to old genera, the *Uraster Gaveyi* is singularly interesting, presenting, as it does, the spectacle of a Liassic echinoderm, which so closely resembles the commonest star-fish now living in the British seas, that it can only be distinguished from it by a minute and critical comparison; and the *Hemicidaris Purbeckensis* is remarkable as being the first member of its tribe ever discovered in strata of the Purbeck series.

The species described and figured have been selected from formations of different geological epochs. From Silurian rocks *Lepidaster Grayii* has been taken; from older secondary strata, the two forms of *Hemicidaris*, the *Galerites* (*Holactypus*) *hemisphærica*, chosen on account of its being new to Britain, and also affording an excellent illustration of the sub-genus to which it belongs, and the *Dysaster ringens*, selected for the same reasons; also the new star-fishes, species of *Uraster* and *Tropidaster*, already alluded to. Of cretaceous fossils there are the critical *Galerites castaneus*, and the characteristic *Galerites albogalerus* and *Micraster cor-anguinum*.

A third series of illustrations of the fossil Echinoderms is far advanced, and in preparation for publication.

EDWARD FORBES.

June, 1850.

# BRITISH FOSSILS.

## DECADE III. PLATE VIII.

### GALERITES (GALERITES) ALBOGALERUS.

[Genus *GALERITES*. LAMARCK. (Sub-kingdom Radiata. Class Echinodermata. Order Echinidæ. Family Cassidulidæ.) Body more or less hemispherical, always tumid; ambulacra simple, continuous, radiant; mouth central, inferior; anus inferior or sub-marginal; tubercles perforate.]

[Sub-genus *Galerites*. Body hemispheric, sub-globose, or conical; base more or less flattened; tubercles irregularly arranged.]

SYNONYMS. *Conulus albogalerus*, LESKE, ap Klein, p. 162, pl. 13, figs. A, B. *Echinus albo-galerus*, GMELIN, p. 3181, No. 46. *Galerites albo-galerus*, LAMARCK, vol. iii., p. 306; DESMOULINS, Tab. Syn. p. 248; GOLDFUSS, Pet. Genn., p. 127, pl. 40, fig. 19; STOKES, Geol. Trans., 2nd series, vol. ii., p. 406, pl. 45, figs. 14, 15; DESOR, Monog. des Galerites, p. 4, pl. 1, figs. 4-11, and 13, fig. 7; AGASSIZ and DESOR, Cat. Rais. des Echin., Ann. des Sciences Nat., 3rd ser., vol. vii., p. 148. *Conulus albogalerus*, FLEMING, Brit. An. p. 481; MANTELL, Geol. Sussex, pl. 17, figs. 8, 20; PARKINSON, Org. Rem., vol. iii., pl. 2, figs. 10, 11. *Echinoneus albo-galerus*, DE BLAINVILLE, Zooph., p. 194. *Discoidea albogalera*. AGASSIZ, Prod., p. 186; BRONN, Lethæa Geog., p. 614, pl. 29, fig. 18 a, b. *Galerites cretosus*, MANTELL, Medals, vol. i., p. 384.

FORMA *a*. *Normalis*. (The figures quoted above represent the typical form.)

FORMA *β*. *Tumidior*. *Galerites conica*, AGASSIZ; DESOR, Monog. des Galerites, p. 16, pl. 1, figs. 12-19. *Conulus albogalerus*, MANTELL, Geol. Sussex, pl. 17, figs. 8 and 20.

DIAGNOSIS. *G. corpore alto, conoideo, ad basin angulato tuberculis infrâ majoribus; ano elliptico, infero, submarginali, margine incrassato subrostrato; poris ambulacralibus ad orem compacte confertis.*

The general form of the *Galerites albogalerus* is that of a sugar-loaf, pyramidal or conical, with a flattened base; varying from a tall pyramid with very steep sides to a short one with swelling sides, always compressed and subangular at the junction of the sides or dorsal surface with the base or ventral surface. Above, it is divided into ten areas by the straight radiating avenues of pores; the interambulacral areas



a little below the centre of the sides are equal to from three to three and a-half of the ambulacral areas. In a specimen an inch and four-twelfths high, about 15 plates constituted each half of a dorsal interambulacral area, and about 75 each half of an ambulacral. The greater number of interambulacral plates are nearly equal in vertical diameter, but widen out in transverse dimensions from apex to base. The ambulacrals are minute, and often cuneiform, and are separated from each other not unfrequently by small accessory plates. Rather more than four of the former are equal to the length of the interambulacral plate opposite them. All the dorsal plates are covered with very minute miliary granules, which give but very slight or scarcely any roughness to the surface when it is denuded of spines. These are interspersed with small spiniferous tubercles, numerous, scattered, but presenting an hour-glass like arrangement on each interambulacral plate, one or two on each ambulacral. Each of these spiniferous tubercles is perforated on the apex, and placed on a mammilliform boss with a crenulated summit, and surrounded by a smooth areola.

The base is flat. Its ambulacral and interambulacral areas are studded with numerous spiniferous tubercles larger than those of the dorsal surface; in the former they form oblique rows of fours or at most five, across the whole of each ambulacral space near the margin, and diminishing in number towards the mouth; in the latter they are thickly crowded towards the margin, and ranged towards the mouth in oblong transverse groups, interrupted by raised granulated wavy spaces, which mark the lines of junction of the plates, and forming an arachnoid arrangement of irregular rings on the base, of which the mouth is the centre. The base is elongated postally, thickened and subrostrated for the anus, which is large and broadly elliptical in a longitudinal direction. Its margins are raised and thick. The size of the vent usually exceeds that of the mouth by one-third. The mouth appears round, but is obscurely decagonal, being gently notched at its margins opposite the avenues of pores. It is inflexed opposite each area, the inflexions opposite the interambulacral areas being deeper and semicircular. The pairs of pores are small, ranged in single file down the dorsal surface, falling into series of three pairs on the base soon after passing the margin. The series become more and more oblique until, at the tenth or eleventh from the base, they are directly under each other, and consequently give considerable breadth to the avenues. Three lines drawn up each avenue in the inner half of its basal course will intersect one of the pair of pores of each series.

The miliary tubercles of the dorsal plates bear very minute and short tubercular smooth spines, each standing apart from its neighbours. The spines on the tubercles of the upper surface I have not seen.

Those of the lower surface are two-tenths of an inch in length, slender, tapering, smooth, longitudinally ridged with about eight ridges and enlarged at the base, where they are surrounded by a crenulated collar. Curious club-tipped pedicellaria-like bodies occur among them, which may represent the spines of the miliary tubercles described as occurring on the dorsal surface.

Mr. Bowerbank has communicated the result of a microscopic examination of the spines of *Galerites* in his possession. He finds the small dorsal spines of *Galerites albogalerus* to differ from those of *subrotundus* in being thickened at the base and set on the tubercles as it were sessile, instead of being shortly pedunculated, as they are in the latter species. The minute moniliform spines of *G. albogalerus* are  $\frac{1}{15}$  of an inch in length and of equal diameter. Three were measured, and all were as nearly as possible of the same size and proportions. They were all perfectly smooth.

The apex of the body is the highest point of the back. The apical disk is formed of five genital and five ocular plates. Four of the former are perforated for the oviducts in their lower halves; one of the perforated plates is greatly enlarged above, to form the centre of the disk, where it is wrinkled and punctured, constituting the madreporiform plate. The fifth posterior and odd genital plate is very small, triangular, and imperforate. The perforations of all are nearly marginal.

The existence of a dental system in *Galerites* was made known by Mr. Charles Stokes, who communicated his discovery to the Geological Society. A second specimen with teeth adorns the collection of Mr. Bowerbank, and in it the dental "lantern" is sufficiently protruded to enable us to determine the form and structure of its principal elements. The teeth are smooth, white, lanceolate, triangular, each consisting of a concave lamina terminating below in the dental point, and strengthened on its back by a prominent rounded ridge. In the "Catalogue Raisonné des Echinides," the authors have by an oversight attributed as a character to the *Cassidulidæ*, the absence of a masticatory apparatus. It is probable that all the members of that family had a dental system similar to that of *Galerites*. The absence of traces of it in fossil specimens must be accounted for in the same way in which we know the absence of the dental lantern in dead specimens of existing *Echini* to have been caused, *viz.*, by the decay of the internal parts and the disarticulation of the segments of the masticatory apparatus.

The following table of the relative dimensions of nine specimens, among those in the collection of the Geological Survey, will give some idea of the variable proportions in this species.

No. of Specimen.	Length at Base.	Breadth at Base.	Height.	Lat. Diameter at a Fourth of the Height from the Apex..
	Inch.	Inch.	Inch.	Inch.
1	$1\frac{7}{12}$	$1\frac{1}{12}$	$1\frac{7}{12}$	$0\frac{8}{12}$
2	$1\frac{7}{12}$	$1\frac{6}{12}$	$1\frac{6}{12}$	$0\frac{11}{12}$
3	$1\frac{8}{12}$	$1\frac{5}{12}$	$1\frac{5}{12}$	$0\frac{10}{12}$
4	$1\frac{8}{12}$	$1\frac{5}{12}$	$1\frac{3}{12}$	$0\frac{8}{12}$
5	$1\frac{7}{12}$	$1\frac{6}{12}$	$1\frac{3}{12}$	$0\frac{8}{12}$
6	$1\frac{8}{12}$	$1\frac{6}{12}$	$1\frac{2}{12}$	$0\frac{9}{12}$
7	$1\frac{4}{12}$	$1\frac{2}{12}$	$1\frac{1}{24}$	$0\frac{6}{12}$
8	$1\frac{9}{12}$	$1\frac{7}{12}$	$1\frac{3}{12}$	$0\frac{10}{12}$
9	$1\frac{2}{12}$	$1\frac{1}{12}$	$0\frac{9}{12}$	$0\frac{7}{12}$

*Affinities.*—In the valuable Monograph of *Galerites* by M. Desor, there are eleven species of the genus (in its most restricted sense) enumerated, all of which would rank, according to the views we have adopted in these memoirs, as members of the sub-genus *Galerites*. Nine, if not the whole eleven of Desor's species are found in British cretaceous strata. After a careful consideration of figures, specimens, and citations, I have come to the conclusion that the whole eleven may be reduced to only four true species, one of them the *Galerites* before us, the other three very nearly allied forms. The species of the sub-genus *Galerites* which I recognize as truly entitled to that rank are the following:—

1st. *G. albogalerus*; first so named by Klein on account of its fancied resemblance to the white caps worn by the priests of Jupiter, the common form here figured and described in detail, previously noticed by many old writers and sometimes rudely figured; it was adopted into strict scientific nomenclature by Gmelin in the thirteenth edition of the "Systema Naturæ." There was never any mistake about the typical form of this species, and though the generic name has been frequently changed, the old and appropriate specific denomination has been held sacred and should be kept. I regret, therefore, that Dr. Mantell should have recently applied to it a new epithet—the word *cretaceus*, applicable to all the species of the sub-genus *Galerites*, in his excellent popular manual of Palæontology, the "Medals of Creation."

The fourth species in M. Desor's Monograph, is one of the commonest varieties of *albogalerus*, elevated to a species by Agassiz, under the name of *Galerites conica*. Every gradation of outline between it and the typical form (which is the more conical of the two) is to be met with abundantly in the English chalk. In describing it, M. Desor has carefully contrasted its characters with *G. vulgaris*; the distinctions he



enumerates are those which separate the latter from *albogalerus*. He remarks, that possibly the *conica* may prove to be the male of *vulgaris*. For stratigraphical reasons, I do not think this can be the case, but were it so, then *albogalerus* as a whole must be taken as the male of *vulgaris*. It is more probable that the pyramidal and tumid forms of *albogalerus*, considered distinct by Agassiz and Desor, under the names *albogalerus* and *conica*, may be respectively male and female; but even this hypothesis I abstain from proposing, when I see the complete and gradual transition which specimens exhibit between the two extremes of form.

2. *G. abbreviatus*.—Certain old figures in the works of Klein, Leske, and others gave origin to the establishment of a *Galerites* under the names of *abbreviatus* (Lamarck), *truncatus* (Defrance), and (in part) *vulgaris*. The synonymy of this type is fully given by M. Desor, with excellent figures of one of its ordinary varieties (Monog. des *Galerites*, tab. 3, figs. 9-17). It is the *Galerites vulgaris* of Goldfuss and of Bronn, and another variety is the *Galerites abbreviatus* of the former author, which in the "Catalogue Raisonné," M. Desor elevates to distinct rank as *G. oblongus*. It is the *Comulus vulgaris* figured by Parkinson, and probably the species enumerated under that term by Mantell. Varieties of it are figured under the names of *Galerites vulgaris*  $\alpha$  and  $\beta$ , by Woodward, in his "Geology of Norfolk," plate 5, figs. 2 and 3, as has been proved to me from specimens by my friend Mr. S. P. Woodward, of the British Museum, who has further indicated to me its identity with the *Galerites angulosa* of Desor (Monog. des Gal., plate 4, figs. 5-7), and *Carotomus hemisphæricus* of Desor (Monog. p. 37, plate 5, figs. 14, 15), both founded on well-known English specimens in the collection of the Marquis of Northampton, and of which I have examined exact parallels in the museum of Mr. Bowerbank, the former, indeed, being identical with *Galerites vulgaris* of the "Geology of Norfolk," and the latter with var.  $\beta$  of the same work. Moreover, I have scarcely a doubt that the *Galerites pyramidalis* of the "Monograph des *Galerites*," plate 1, figs. 1 to 3, founded on a single flint-cast—a most insufficient ground in this genus upon which to constitute a distinct species,—is also *Galerites abbreviatus*.

The number of spurious species which have thus been constituted out of one, is scarcely to be wondered at, when the extreme variability of its shape is considered. Of the specimens I have seen with the shell preserved no two are alike, and certainly the extremely depressed *Carotomus hemisphæricus* might very fairly be regarded as at least specifically distinct, were it not that characters sounder than mere outline, mark it as the same, and that all intermediate gradations of convexity may easily be shown. From *Galerites albogalerus* this species is truly distinguished

by the constant rotundity of its basal margin, which is *tumidly rounded*, instead of being subangularly compressed. The ambulacral areas are usually prominent, often so much so as to give a strong angularity to the contour, and always narrower in proportion to the interambulacra than in the other species. The anus is inferior, strongly and tumidly prominent and margined, and always either *round* or *broadier than long*, a character never present in its congeners. The whole surface above and below is rough with granulations, interspersed with the primary tubercles, which are *nearly equal* on the ventral and dorsal surfaces. The miliary granulation is quite as strong above as below, and strikingly contrasts with the apparent smoothness of the surface which distinguishes *albogalerus* and *subrotundus*. The margins of the mouth are usually tumid, and the avenues of pores when advancing to it, do not become so closely ranked as in the species just named. *Galerites abbreviatus* appears to be characteristic of the upper chalk.

3. *G. subrotundus*.—Although this name was given by Agassiz to a single English specimen, and previously by Mantell to a questionable cast, I prefer retaining it to using that of *vulgaris*, adopted, after Lamarek, by Agassiz and Desor, for what I regard as perhaps the more ordinary form of the same species. I reject the latter name, since under it so many good figures of the last species mentioned have been published, and adopt *subrotundus*, since one of its forms has been excellently figured under that name by Desor, and since it has not been applied to any other species. It is a common English Galerite, and apparently is chiefly confined to a lower geological horizon than that of the two preceding species, being chiefly characteristic of the hard or lower chalk. In form, it varies from a depressed spheroid with a truncated base to nearly globular; the anus is always vertically elliptical, not rostrated nor tumid, and is placed on, or in some occasional specimens, above the margin. The mouth is central. The margins of the sides are always more or less rounded. The spiniferous tubercles of the base are conspicuously larger than those of the dorsal surface, but all are smaller and more numerous than those of *albogalerus*. The spines of the lower surface are smaller and different. The pairs of pores fall into close ranks near the mouth, but are more oblique, and the series are not so directly under each other as in *albogalerus*. The *Galerites globulus* of Desor, founded on a single white-chalk English specimen, is a not rare but exceptional dwarf variety, and *Globator nucleus* of Agassiz is something too like an abnormality of this species. *Galerites Leskii* (Desor), is another variety.

4. *Galerites castanea*, with which I unite *Pyrina depressa* and *Galerites lævis*, possibly also *Galerites Orbignyana* (founded on a single specimen from Touraine) may fall in here. But of this fourth species I have fully treated in the account of *Galerites castanea*.

I cannot reconcile the *Galerites globosus* and *Galerites elongatus* of F. A. Römer ("Versteinerungen des Norddeutschen Kreidegebirges," Pl. VI., figs. 14 and 15) with any of the above. The figures are, however, very bad, and it is not improbable that the former may prove identical with the *nucleus* variety of *subrotundus*, and the latter with some form of *abbreviatus*.

A fifth species of true *Galerites*, but one not hitherto found in Britain, is the *G. subsphæroidalis* of D'Archiac, described and figured in that geologist's excellent account of the fossils of the Tourtia. It is allied to *G. subrotundus*, but is perfectly distinct, and should be sought for in the upper beds of the English lower green-sand, where many Tourtia fossils occur.

*Localities and Geological Position.*—This species is found distributed throughout the white chalk of the English cretaceous districts. It is very abundant in the south. Very fine specimens are found in Kent, as at Gravesend, &c. Examples with spines are contained in the Museum of the Geological Survey, and in Mr. Bowerbank's collection. Specimens showing the teeth are in the collections of Mr. Stokes and Mr. Bowerbank. Some interesting forms have been presented to the Survey by Mr. Wetherell.

*Foreign Localities.*—White chalk of France, Germany, and Belgium, apparently not universally diffused through the spread of this formation.

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#### DESCRIPTION OF THE PLATE.

Fig. 1. Profile of the most common variety.

Fig. 2. The same seen from below.

Fig. 3. Outline (lateral view) of an extremely pyramidal specimen.

Fig. 4. Outline (lateral view) of an extremely depressed and tumid variety.

Fig. 5. Ambulacral and interambulacral plates, pores, and tubercles, taken from the centre of the sides.

Fig. 6. Arrangement of pores and tubercles in the neighbourhood of the mouth.

Fig. 7. Spiniferous tubercles and miliary granules taken from the base.

Fig. 8. Greatly magnified figures of the small tubercular spines of the dorso-lateral plates.

Fig. 9. *a.* One of the spines of the lower surface highly magnified. *c.* Its section. *d.* Pedicellaria-like body, intermixed with the spines. *b.* Portion of spine of *Galerites subrotundus* for comparison.

Fig. 10. Masticatory apparatus, natural size. *a.* The same seen from one side, highly magnified. *b.* One of the teeth seen in profile.

Fig. 11. Diagram of the supports of the masticatory apparatus around the inner rim of the mouth.

Fig. 12. Apical disk; genital and ocular plates.



*Subgenera and Species of Galerites found in Britain.*

## Genus. GALERITES.

Subgenus I. GALERITES (the British species are all upper-cretaceous).

1. *albogalerus*, Klein.
2. *abbreviata*, Lamarck.
3. *subrotunda*, Mantell.
4. *castanea*, Brongniart.

Subgenus II. CAROTOMUS.

1. *rostrata*, Agassiz (upper green sand).

Subgenus III. DISCOIDEA (all the British species are cretaceous).

1. *cylindrica*, Lamarck.
2. *favrina*, Desor.
3. *subuculus*, Leske.
4. *Dixoni*, Forbes.

Subgenus IV. HOLECTYPUS (all the British species are oolitic).

1. *depressa*, Leske.
2. *hemisphærica*, Agassiz.

EDWARD FORBES.

June, 1850.



Geological Survey of the United Kingdom.

GALERITES  
(Cretaceous)

